

Pacific Halibut Discard Mortality Rates in the 2004 CDQ Groundfish Fisheries, With Recommendations For Monitoring in 2006

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Abstract

Results from analysis of halibut release condition and injury data collected in the 2004 Community Development Quota groundfish fisheries are presented. Halibut discard mortality rates are calculated, and the results vary by gear and fishery target. Mean annual rates are calculated as a basis for recommendations for the 2006 CDQ trawl, longline and pot operations in the Bering Sea/Aleutian Islands region. The mean rates differ very little from rates used in 2005.

Introduction

Pacific halibut discard mortality rates (DMRs) in the Alaskan groundfish fisheries are estimated from viability data collected by National Marine Fisheries Service (NMFS) observers. Analysis by staff of the International Pacific Halibut Commission (IPHC) results in recommendations to the North Pacific Fishery Management Council (NPFMC or Council) for managing halibut bycatch in subsequent seasons. This paper describes the results from an analysis of data collected from the 2004 Community Development Quota (CDQ) fishery and includes DMR recommendations for the 2006 fishery.

Data Used and Methods

Observer haul-by-haul data from the NMFS groundfish observer database were used for this analysis. The data records included the catch of groundfish by species or species group, estimates of the number and weight of halibut bycatch, and the number and length of halibut sampled for release viability or injury by category (excellent/poor/dead for trawl and pot gear, minor/moderate/severe/dead for longline gear). Records for all hauls sampled by observers in 2004 were obtained; hauls not sampled for species composition were excluded.

The first task was to partition the records into target fishery categories. The catch composition for each sampled haul was summed, and the target assigned based on the percentage of particular species within the haul catch composition (Williams 1997).

The targeting determination was based on a series of assumptions about the total catch and retained catch. Midwater pollock hauls were identified and coded if that species comprised 95% of the total catch. The determination for the remaining targets assumes that all arrowtooth flounder caught in a haul were discarded; the remaining species are assumed retained. Target determination was based on the species/species group comprising the greatest percentage of the “retained” catch. Flatfish targets in the Bering Sea/Aleutian Islands (BSAI) were determined in a succession of comparisons of individual flatfish species compositions in the catch. Table 1 shows the target codes and definitions used in this analysis.

NMFS observers examine halibut for the release viability or injury upon return to the sea. Each fish is judged according to a set of criteria (Williams and Chen 2003), which are used to determine internal and external injuries, and body damage from predators (e.g., sand fleas and others). Beginning in 2000, a dichotomous key was provided to reduce subjectivity in the determinations of condition. Observers record the number of excellent, poor and dead condition (trawls and pots) or minor, moderate, severe, and dead (longlines) halibut for each haul/set sampled. Viability samples are only collected on hauls sampled for species composition. The species composition sampling provides an estimate of the total number of halibut caught in the haul, as well as the catch of groundfish, necessary for determining the target. Observers are instructed to limit the number of fish examined to a maximum of 20, although this is occasionally exceeded by enthusiastic observers.

Next, the viability distribution is calculated. First, for each haul, the proportion of halibut in each category is extrapolated up to the total number of halibut caught. The extrapolated numbers of excellent, poor, and dead halibut are then summed within each region/gear/target strata.

The general model for calculating the DMR for halibut caught by gear g is of the form:

$$DMR_g = \sum_{i=1}^4 (m_{i,g} \times P_i)$$

where m is the mortality rate for gear g , and P is the proportion of halibut in condition i , where 1 is excellent/minor, 2 is poor/moderate, 3 is dead/severe, and 4 is dead.

The mortality rate m varies among gear types (see Clark et al. (1992) for trawls, Williams (1996) for pots, and Kaimmer and Trumble (1998) for longlines) and represents the aggregate effects of external and internal injuries to the fish and the presence of predation by amphipods or marine mammals. There can be many sources of injuries, which vary by gear type. For longlines, injuries are most frequently caused by improper release methods used by vessel crews. Other significant factors include the length of the soak time, which can exacerbate the mortality caused by hooking injuries and also increase the potential for amphipod predation. Halibut mortality rates by gear and condition/injury are shown in the following table:

Gear (g)	m_{exc}	m_{poor}	m_{dead}	
Trawl	0.20	0.55	0.90	
Pot	0.00	1.00	1.00	
	m_{minor}	$m_{moderate}$	m_{severe}	m_{dead}
Longlines	0.035	0.363	0.662	1.00

Mean fishery DMRs and associated standard errors have been estimated by assuming that each vessel was a separate sampling unit, enabling a DMR to be calculated for each individual vessel in a target fishery. The DMR for a target fishery is then estimated as the mean of vessel DMRs, where the vessel's proportion of the total number of bycaught halibut is used as a weighting factor as follows:

$$\begin{aligned} \text{Let } DMR_v &= \text{observed DMR on vessel } v \\ p_v &= \text{proportion of total number of halibut caught on vessel } v \text{ in a fishery} \end{aligned}$$

$$\text{Then } \overline{DMR} = \sum_{v=1}^n (p_v \times DMR_v)$$

Standard errors of the weighted mean DMR were estimated as:

$$V(\overline{DMR}) = \sum_{v=1}^n (p_v^2 \times V(DMR_v))$$

$$\text{and } SE(\overline{DMR}) = \sqrt{V(\overline{DMR})}$$

where $V(DMR_v)$ is the sample variance of all the DMR_{s_v} , and $V(\overline{DMR})$ and $SE(\overline{DMR})$ are the variance and standard error of \overline{DMR} , respectively.

Results for 2004 CDQ Fisheries

A summary of observer coverage, sampling, and halibut viability data is shown in Table 2. In 2004, pot, trawl, and longline gear was used in CDQ fishing. Targeted species included pollock, Atka mackerel, and yellowfin sole by trawls, Pacific cod by longline, and sablefish by pots.

Almost all halibut caught in the trawl operations were dead when examined. The resulting DMRs ranged from 0.84 to 0.90, which are generally higher than what is seen in open access fishing for the same target species.

Longline CDQ fishing consisted of 21 vessels targeting cod. Distribution of release injuries to halibut in the CDQ longline cod fishery was similar to that observed in the open access cod fishery, with a very similar DMR (0.09). The DMR remained unchanged from 2002.

Pot effort in 2004 was focused on sablefish, with five vessels observed. DMRs were significantly higher (0.18 vs. 0.06) than what is normally seen in the BSA open access fishery for cod. This difference is probably due to the different target species. Sablefish is fished at greater depths, ranging from 200 to 575 fathoms, and pot soaking times average 4-5 days.

Recommendations for 2006 CDQ fishery DMRs

A mean annual DMR for all targets was calculated using data from all available years, as a basis for the recommendations for 2006. In most cases, there are at least five years of data, and up to seven years for pelagic pollock and longline cod. These mean annual DMRs are shown in Table 3, and summarized as our recommendations in Table 6. For those targets with no recent information, including trawl flathead sole and rockfish, longline turbot, and pot cod, we recommend using DMRs derived from open access fisheries.

All recommendations for CDQ monitoring are summarized in Table 6.

Status of open access fishery DMRs

In 2000, IPHC proposed, and the Council adopted, a plan to use a long-term average DMR for all open access fisheries for 2001-2003. At the end of that period, new long-term DMRs would be recalculated using the data collected in subsequent years and revisions recommended. In 2000, DMRs for 2001-2003 were recommended, using an average of 1990-1999, which were the most current data available at that time. Williams and Chen (2003) updated this process, with recommendations for 2004-2006, based on data from 1993-2002. Thus, no

changes are proposed for the open access fisheries at this time. We anticipate providing recommendations to the Council in 2006 for the 2007-2009 seasons.

References

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Kaimmer, S. M., and Trumble, R. J. 1998. Injury, condition, and mortality of Pacific halibut bycatch following careful release by Pacific cod and sablefish longline fisheries. *Fish. Res.* 38(2):131-144.

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Table 1. 2004 groundfish target definitions and target determination method used to classify observer sampled hauls in the halibut discard mortality rate analysis.

BSAI		GOA	
Target	Definition	Target	Definition
A	Atka mackerel	A	Atka mackerel
B	Bottom pollock	B	Bottom pollock
C	Pacific cod	C	Pacific cod
F	Other flatfish	D	Deep water flatfish
K	Rockfish	H	Shallow water flatfish
L	Flathead sole	K	Rockfish
O	Other spp.	L	Flathead sole
P	Pelagic pollock	O	Other spp.
R	Rock sole	P	Pelagic pollock
S	Sablefish	S	Sablefish
T	Greenland turbot	W	Arrowtooth flounder
Y	Yellowfin sole	X	Rex sole

OPEN ACCESS and CDQ TARGET DETERMINATION

Bering Sea/Aleutians

- P** if Pollock \geq 95% of total catch, or
- Y/R/L/F** if (rock sole + other flatfish + yellowfin sole + flathead) is the largest component of the retained catch using this rule:
 - Y** if yellowfin sole is \geq 70% of (rock sole + other flatfish + yellowfin sole + flathead sole), or
 - R** if rock sole > other flatfish and rock sole > flathead sole, or
 - L** if flathead sole > other flatfish and flathead sole > rock sole, or
 - F** if none of the three conditions above are met.

If target is not P, Y, R, L or F, then target is whichever species or species group (A, B, C, K, O, S, T) forms the largest part of the Total Catch.

Gulf of Alaska

- P** if Pollock \geq 95% of total catch, or
- W** if Arrowtooth flounder \geq 65% of total catch.

If target is not P or W, then target is whichever species or species group (A, B, C, D, H, K, L, O, S, X) forms the largest part of the Total Catch.

Table 2. Observer coverage and halibut viability/injury data collected from the 2004 Bering Sea/Aleutian CDQ fisheries.

Target	No. of Vsls	# of Hauls	Raw Data					Extrapolated data					
			Exc./ Minor	Poor/ Mod.	Dead/ Sev.	Dead	DMR	Exc./ Minor	Poor/ Mod.	Dead/ Sev.	Dead	DMR	SE
<i>CDQ Longline</i>													
P cod	21	715	2129	155	20	48	0.082	38127	3117	813	749	0.088	0.017
<i>CDQ Pot</i>													
Sable	5	192	285	18	45	-	0.181	706	47	104	-	0.176	0.021
<i>CDQ Trawl</i>													
Atka m.	2	128	2	0	60	-	0.877	63	0	1329	-	0.869	0.019
Btm pol	5	71	1	22	210	-	0.864	22	573	2760	-	0.836	0.049
Pel pol	12	740	1	4	780	-	0.897	2	9	2200	-	0.898	0.002
YF sole	3	247	6	15	292	-	0.870	138	451	14541	-	0.883	0.011

Table 3. Summary of halibut discard mortality rates (DMRs) in the CDQ Bering Sea/Aleutian Islands (BSAI) groundfish fisheries during 1998-2004.

Gear/Target	1998	1999	2000	2001	2002	2003	2004	1998-2004 Mean DMR
<i>CDQ Trawl</i>								
Atka mackerel	-	82	89	80	90	86	87	86
Bottom pollock	90	88	90	90	66	-	84	85
Flathead sole	-	-	83	90	-	-	-	87
Pelagic pollock	90	90	88	89	89	90	90	89
Rockfish	-	88	-	90	-	-	-	89
Yellowfin sole	-	83	-	-	81	89	88	85
<i>CDQ Longline</i>								
Pacific cod	10	10	13	11	9	9	9	10
Turbot	-	-	4	-	-	-	-	4
<i>CDQ Pot</i>								
Pacific cod	-	-	7	2	-	-	-	5
Sablefish	-	-	38	46	25	22	18	30

Table 4. Summary of halibut discard mortality rates (DMRs) in the Open Access (non-CDQ) Bering Sea/Aleutian Islands (BSAI) groundfish fisheries during 1990-2003. Mean DMR for 1993-2002 used for managing bycatch during 2004-2006.

Gear/Target	'90	'91	'92	'93	'94	'95	'96	'97	'98	'99	'00	'01	'02	'03	DMR Used in 2004-2006¹
<i>BSAI Trawl</i>															
Atka mackerel	66	77	71	69	73	73	83	85	77	81	77	73	85	67	78
Bottom pollock	68	74	78	78	80	73	79	72	80	74	67	74	78	65	76
Pacific cod	68	64	69	67	64	71	70	67	66	69	69	69	69	67	68
Other Flatfish	80	75	76	69	61	68	67	71	78	63	76	81	77	79	71
Rockfish	65	67	69	69	75	68	72	71	56	81	89	85	73	84	74
Flathead sole	-	-	-	-	67	62	66	57	70	79	74	69	60	69	67
Pelagic pollock	85	82	85	85	80	79	83	87	86	87	88	89	90	89	85
Rock sole	64	79	78	76	76	73	74	77	79	81	75	77	83	82	77
Sablefish	46	66	-	26	20	-	-	-	-	90	60	-	-	-	49
Turbot	69	55	-	-	58	75	70	75	86	70	74	68	75	67	72
Yellowfin sole	83	88	83	80	81	77	76	80	82	78	77	74	77	81	78
<i>BSAI Pot</i>															
Pacific cod	12	4	12	4	10	10	7	4	13	9	13	6	5	6	8
<i>BSAI Longline</i>															
Pacific cod	19	23	21	17	15	14	12	11	11	12	12	12	10	8	11
Rockfish	17	55	-	6	23	-	20	4	52	-	12	10	4	-	16
Sablefish	14	32	14	13	38	-	-	-	-	-	-	-	-	-	-
Turbot	15	30	11	10	14	9	15	22	18	17	14	6	23	7	15

¹ Mean DMR for 1993-2002 and adopted by NPFMC at Dec. 2003 meeting.

Table 5. Summary of halibut discard mortality rates (DMRs) in the Gulf of Alaska (GOA) groundfish fisheries during 1990-2003. Mean DMR for 1993-2002 used for managing bycatch during 2004-2006.

Gear/Target	'90	'91	'92	'93	'94	'95	'96	'97	'98	'99	'00	'01	'02	'03	DMR Used in 2004-2006¹
<i>GOA Trawl</i>															
Atka mackerel	67	89	81	67	53	-	60	-	-	-	-	-	-	-	60
Bottom pollock	51	62	66	57	48	66	79	66	55	55	52	58	55	47	59
Pacific cod	60	62	66	59	53	64	70	62	64	54	57	67	59	69	61
Deep wtr flats	61	58	70	59	60	56	71	61	51	51	62	49	48	31	57
Shallow wtr flats	66	71	69	65	62	70	71	71	67	81	67	62	66	80	68
Rockfish	65	75	79	75	58	71	65	63	68	74	71	61	64	65	67
Flathead sole	-	-	-	-	54	64	67	74	39	51	69	68	74	49	62
Pelagic pollock	71	82	72	63	61	51	81	70	80	86	80	89	90	34	75
Sablefish	70	60	68	59	67	58	80	61	-	68	38	66	62	-	62
Arrowtooth fldr	-	-	-	-	-	-	66	48	62	73	75	86	76	70	69
Rex sole	-	-	-	-	56	76	63	47	58	70	71	62	57	69	62
<i>GOA Pot</i>															
Pacific cod	12	7	16	24	17	21	7	11	16	13	8	33	19	21	17
<i>GOA Longline</i>															
Pacific cod	15	18	13	7	11	13	11	22	11	17	16	11	11	13	13
Rockfish	6	-	-	7	-	4	13	-	9	-	9	-	-	-	8
Sablefish	17	27	28	30	22	-	-	-	-	-	-	-	-	-	--

¹ Mean DMR for 1993-2002 and adopted by NPFMC at Dec. 2003 meeting.

Table 6. Summary of recommended Pacific halibut discard mortality rates (DMRs) for calculating bycatch mortality in the 2006 CDQ groundfish fisheries off Alaska.

Gear/Target	Used in 2005	2006 Recommendation
<i>CDQ Trawl</i>		
Atka mackerel	85	86
Bottom pollock	85	85
Flathead sole	67 ^a	67 ^a
Pelagic pollock	90	89
Rockfish	74 ^a	74 ^a
Yellowfin sole	84	85
<i>CDQ Longline</i>		
Pacific cod	10	10
Turbot	15 ^a	15 ^a
<i>CDQ Pot</i>		
Pacific cod	8 ^a	8 ^a
Sablefish	33	30

^a Open access fishery DMRs.